#11/Appeal Brief
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M. Watts
4/15/04



**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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| In re application of: | James A. Hagan, et al. | : | Date: April 1, 2004 |
| Group Art Unit: | 3723 | : | IBM Corporation |
| Examiner: | E. Ojini | : | Intellectual Property Law |
| Serial No.: | 09/954,812 | : | Dept. 917, Bldg. 006-1 |
| Filed: | September 17, 2001 | : | 3605 Highway 52 North |
| Title: EDGE FINISHING PROCESS FOR GLASS OR CERAMIC DISKS USED IN DISK DRIVE DATA STORAGE DEVICES | | : | Rochester, MN 55901 |

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450



**APPEAL BRIEF IN SUPPORT OF APPEAL**

**FROM THE PRIMARY EXAMINER TO THE BOARD OF APPEALS**

Sir:

This is an appeal of a Final Rejection under 35 U.S.C. §103(a) of claims 1-20 of Application Serial No. 09/954,812, filed September 17, 2001. This brief is submitted pursuant to a Notice of Appeal filed February 4, 2004, as required by 37 C.F.R. §1.192.

## 1. Real Party in Interest

International Business Machines Corporation of Armonk, NY, is the real party in interest. The inventors assigned their interest as recorded on September 17, 2001, on Reel 012182, Frame 0360.

## 2. Related Appeals and Interferences

There are no related appeals nor interferences pending with this application.

## 3. Status of Claims

Claims 1-20 are pending and stand finally rejected. Claims 21-43 were cancelled in response to a restriction requirement, and are not at issue in the present appeal. The claims on appeal are set forth in Appendix A.

## 4. Status of Amendments

No amendments were filed following the Final Rejection.

## 5. Summary of Invention

The invention herein relates to the manufacture of recording disks used in digital data storage devices, such as rotating magnetic "hard" disk drive data storage devices. Such disk drives have traditionally used aluminum disks, although in recent years some designs have used glass as a disk material (Spec, p. 2, lines 11-18). The present invention is applicable to the manufacture of glass or ceramic disks (Spec p. 3, lines 18-20). Recording disks of any material have extremely demanding requirements in terms of flatness, smoothness, strength, etc (Spec. p. 2, lines 1-9). Conventionally, glass recording disks are initially formed from sheet glass, which is cut into disk blanks (Spec p. 2, lines 21-23). The cutting process for cutting the blanks leaves rough circumferential edges (Spec p. 3, lines 1-2). Although data is not recorded on these edges, left untreated they would

deteriorate under the stresses of operation (Spec p. 3, lines 2-4). To prevent such deterioration, disks edges are conventionally finished to a required smoothness using one or more grinding and polishing process steps (Spec. p. 3, lines 4-6). Furthermore, the disk is subjected to chemical strengthening, which inhibits crack propagation at the circumferential edges (Spec. p. 3, lines 6-7). In accordance with appellants' preferred embodiment, the circumferential edges of a disk are instead ground in a ductile grinding regime (Spec. p. 3, lines 18-24). Ductile grinding is preferably accomplished using vitrified diamond grinding wheels, in which both the disk and wheels are rotated on air bearing spindles at high speed and in opposite directions, under a constant radial force (Spec. p. 4, lines 3-8). Ductile grinding in accordance with the preferred embodiment produces a finished disk edge with very few edge fractures (Spec. p. 4, lines 16-20). Such a disk has sufficient mechanical strength to withstand the stresses of operation, without further chemical strengthening (Spec. p. 4, lines 16-20). Therefore, according to the preferred embodiment, the disk is made of glass which is not chemically strengthenable (Spec. p. 3, line 25 - p. 4, line 3).

**6. Issues**

Claims 1 and 3-7 are finally rejected under 35 U.S.C. §103(a) as unpatentable over Kuramoto (JP 1005759) in view of Wang et al. (US 5,447,466) and further in view of Boucher et al. (US 5,718,615). Claims 2 and 8-20 are finally rejected under 35 U.S.C. §103(a) as unpatentable over *Kuramoto* in view of *Wang* and *Boucher*, and further in view of Bajorek (US 6,363,599). The only issue in this appeal is whether the claims are prima facie obvious in view of the cited references.

## 7. Grouping of Claims

Appellants expressly state that, for purposes of appealing the grounds of rejection advanced by the Examiner herein, the claims do not all stand or fall together. For purposes of the present appeal, appellant has divided the claims into two groups, the claims within each group being deemed to stand or fall together:

Group I, consisting of claims 1-9, 11 and 17; and

Group II, consisting of claims 10, 12-16, and 18-20.

However, in the event that new references are cited or new arguments advanced for rejection of the claims, appellants reserve the right to argue that additional claims do not stand or fall together.

## 8. Argument

Appellants assert that the Examiner failed to establish adequate grounds of rejection for the following reasons:

I. There is no suggestion in the art to combine the references (particularly *Kuramoto* and *Wang*) in such a manner as to teach or suggest finishing the edges of data recording disks in a ductile grinding regime, a basis for all rejections herein.

II. None of the cited references teach or suggest a specific method for edge finishing a recording disk with a finishing apparatus which obviates the need for chemical strengthening, a key limitation of all the Group II claims herein.

**Overview of Invention**

A brief overview of appellants' invention in light of existing art will be helpful in appreciating the issues herein. Appellants' claims are directed to the manufacture of a specific, special-purpose article, i.e., a recording disk for a disk drive data storage device. Although millions of such articles have been manufactured, and they are commonplace

throughout the world, few people really appreciate how remarkable they are. Each disk drive is a miniature world onto itself, containing its own frame and sealed housing, on-board computer for control, motor and bearings for spinning the disks, actuator for moving the transducer arms, transducer for reading and writing data, and of course, disks for serving as the recording media. It is an enormously complex mechanism, yet it can be mass produced cheaply and reliably.

The competing design considerations and constraints for a recording disk are numerous. Ideally, the disk is perfectly flat and perfectly round. The disk should be lightweight to reduce spindle assembly inertia and facilitate faster acceleration to operating speed and lighter bearing loads. The disk should be strong enough to tolerate high rotational speeds, shock and vibration, and so forth. The disk should be thin to both reduce weight and to reduce the size of the disk drive, but if it is too thin it may warp or lack mechanical strength. The disk substrate material should be non-magnetic (in the case of a rotating magnetic disk drive storage device) to avoid interference with the magnetically encoded data. And finally, the disk should be cheap, because it must be mass produced and sell at a price users will pay.

The marketplace constantly demands improvements to the speed, data capacity, reliability and other parameters of disk drives. Ultimately, all improvements are dependent on the parameters of the recording disk itself. Increased recording density is limited by the smoothness and flatness of the recording surfaces, which permit transducers to fly closer to the surface and data to be reliably encoded in finer increments. Increased speed is limited by the ability to tolerate the increased stresses of greater disk rotational velocity. Therefore, ***the recording disk is central to the design of any disk drive storage device, and either limits or enables almost any improvement that can be made to the device.***

As a result of years of experimentation and research, techniques for manufacturing recording disks have become standardized in the industry. Most disk substrates are of aluminum, and a set of well known processes exist for cutting, machining and polishing aluminum disk substrates for use in data storage devices. In recent years, glass has replaced aluminum in certain demanding applications. Glass provides greater mechanical strength, and, like aluminum, is non-magnetic and can be made to exacting tolerances necessary for use in disk drive devices. Unfortunately, an entirely new set of process steps is needed to manufacture a glass disk substrate, and these processes in general make the glass disk more expensive than aluminum. For this reason, glass disks have typically been used only in applications that have higher design requirements. For example, glass disks are typically used in portable laptop computers, because their greater mechanical strength makes them more tolerant of shock and vibration, whereas aluminum disks are typically used in fixed installations under less stressful conditions, such as offices or data processing centers.

Glass disks are typically cut, ground and polished in multiple steps to produce a finished shape. One set of processes produces a smooth finish on the recording surface, while another set of processes shapes and finishes the circumferential edges, the requirements for the edges being different from the requirements for the recording surfaces. In general, the grinding and polishing steps abrade material using progressively finer abrasives, to produce a smooth finished part. Glass disks are further chemically strengthened to improve the overall mechanical strength of the material.

In conventional glass disk manufacturing processes, chemical strengthening is required because the earlier cutting and edge finishing operations leave small micro-cracks near the edge surfaces. The edges, and particularly the outer circumferential edges, experience high stresses during operation due to high rotational speeds, thin width, slight

warpage, and so forth. Left untreated, these micro-cracks will propagate under normal operational conditions, eventually causing the disk to disintegrate, and consequent disk drive failure. Chemical strengthening is a process involving ion substitution. Typically, the glass material is doped with an ion impurity (such as sodium) before forming, and after the part is formed, cut and finished to a desired shape, it is immersed in an ion bath which exchanges the original ions for those of larger size (such as potassium). Because the potassium is larger than the original sodium, an internal compressive stress is created, which retards the growth of micro-cracks in the glass.

This conventional process produces an acceptable glass disk according to design requirements at the time of filing the present application. But since it can be expected that design requirements will continue to evolve, appellants were investigating improvements to the glass disk manufacturing process in anticipation of changing requirements.

Although chemical strengthening of a conventional glass disk provides adequate mechanical strength and resistance to edge fracture propagation, appellants observed that the ions used in chemical strengthening can leach out under certain conditions, particularly when exposed to high temperatures. This tendency limits the use of certain high-temperature processing steps, such as vapor deposition processes for coating the disk. It may be desirable to use such processes in the future, in order to obtain superior coatings and better recording characteristics. Although these factors are not necessarily generally appreciated in the art, it would for these reasons be desirable to find alternatives to chemical strengthening. Appellants therefore turned to ductile grinding.

Ductile grinding of brittle materials is a known but very rarely induced physical phenomenon. It has been observed in laboratory experiments and described in various

research papers, but is hardly, if ever, used in mass produced articles. Conventional grinding involves moving a grinding surface having a specified roughness against a workpiece under pressure. The rough grinding surface abrades, or breaks away, tiny particles of the workpiece, the size of abraded particles being generally dependent on the surface roughness of the grinding surface. Because the workpiece is brittle, breaking away small pieces is accomplished by a tearing action, which induces tiny fractures near the surface until the pieces break off. This technique leaves small residual fractures at the remaining ground surface. In a ductile grinding regime, the grinding surface is composed of particles which are substantially harder than the workpiece (diamond being the preferred material). Used under just the right conditions of light constant pressure and high relative speed, these particles use something of a cutting or shaving, rather than a tearing, action. The result is a surface with virtually no residual cracks.

It should be emphasized that ductile grinding is an exotic process, which is not necessarily possible for all applications. If possible in a particular application at all, is generally more expensive than any of various conventional grinding or other finishing techniques. It is not likely to be employed absent some special circumstances which justify the added cost.

## I. There is no suggestion in the art to combine the references (particularly *Kuramoto* and *Wang*) in such a manner as to teach or suggest finishing the edges of data recording disks in a ductile grinding regime, a basis for all rejections herein.

In order to support a rejection for obviousness, there must be some suggestion in the art to combine the references in such a manner as to form each and every element of appellants' claimed invention. In this instance, the cited art separately discloses edge

finishing of glass disks (*Kuramoto*, *Bajorek*), and ductile grinding of brittle materials (*Wang*)[1], but there is no suggestion to combine the references to show edge finishing of glass recording disks by ductile grinding, as claimed by appellants in claim group I.[2]

Appellants have already discussed conventional glass disk finishing procedures above, and appellants have always conceded that such techniques are known. However, none of the conventional techniques, and in particular the *Kuramoto* and *Bajorek* references cited by the Examiner do not, teach or suggest the use of ductile grinding for finishing the edges of the disk, or in any other way suggest a combination with the *Wang* reference.

*Wang* is directed to a chemically-assisted machining process for ceramic materials, in which ceramics are machined in the presence of certain halogenated hydrocarbons as accelerants. This process is manifestly not a ductile grinding process, nor is there anything in *Wang* which suggests particular application to data recording disks. However, in *Wang*'s background section can be found the following statement, which forms the basis for the Examiner's rejection:

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[1] *Wang* mentions ductile grinding, but it does not amount to a teaching of that technique, and in particular does not amount to a teaching of that technique as applied to recording disk edges. Appellants will, however, concede that ductile grinding of brittle materials is a known phenomenon. The mere fact that it is a known phenomenon does not mean that a teaching exists for any particular application.

[2] The Examiner apparently bases his rejection of claim group II on the combination of *Wang* and *Kuramoto* (to show ductile grinding of a glass or ceramic recording disk), although ductile grinding is not explicitly recited in these claims, these claims instead reciting the lack of chemical strengthening. The Examiner appears to be reasoning that, if ductile grinding is obvious, then it would have further been obvious to forego chemical strengthening. See discussion in Point II of the argument herein.

> In addition to this conventional process for machining ceramic materials, other processes have found limited use for special applications. These processes include machining by: ultrasonics, abrasive jet or water jet, ductile grinding, ultra-stiff machinery, electro-chemical means to dress the wheel, and lasers. However, only the conventional method using diamond tools has found any commercial significance. [*Wang*, col.1, lines 37-44]

Appellants submit that the above quoted statement provides no suggestion whatsoever to apply ductile grinding to the manufacture of recording disks used in disk drive data storage devices. To the contrary, if anything, the above quoted passage suggests that ductile grinding has very limited application, which would not be suitable for ceramic materials generally, and is not likely to be suitable for a mass produced commercial production process.

Furthermore, the quoted passage provides no teaching of ductile grinding in any particular application, and specifically does not provide a teaching of ductile grinding for the edges of recording disks. It merely mention that ductile grinding exists.

The Examiner's argument appears to be that, given that a known materials process exists, it would have been obvious to use it in a particular application, at a particular stage of manufacturing a particular article. Appellants do not believe the law has so emasculated the inventive process. As explained above, ductile grinding is a rarely used, exotic process having only limited application. Without some suggestion in the art to apply it to the finishing of recording disks, and a showing how it might be done, the rejection based on the combination of references was improper, and appellant's claimed method is not rendered obvious.

**II. None of the cited references teach or suggest a specific method for edge finishing a recording disk with a finishing apparatus which obviates the need for chemical strengthening, a key limitation of all the Group II claims herein.**

The Group II claims do not specifically recite ductile grinding. Rather, these claims recite that the circumferential edge of a recording disk is finished using a finishing apparatus, without chemical strengthening. The Examiner rejected these claims based on the combination of *Kuramoto* and *Wang*, among other references. Since this combination was improper, for the reasons explained above with respect to Point I, the rejection was also improper.

Having said this, in the interests of full disclosure appellants further note that *Bajorek*, cited by the Examiner in rejecting certain dependent claims, further states that alternatives exist to chemical strengthening. Specifically, *Bajorek* mentions that a coating might be applied to the edge, or that the edge might be polished.[3] Appellants therefore briefly address the significance of *Bajorek* with respect to the Group II claims. With respect to the Group I claims, which recite ductile grinding, *Bajorek* contains no teaching or suggestion of a ductile grinding step, as noted earlier.

Although *Bajorek* states that chemical strengthening is optional, its disclosure does not amount to a teaching of a viable alternative. *Bajorek* mentions the use of a coating, but does not state the composition of this hypothetical coating, or the conditions under which it

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[3] *Bajorek*, Col. 5, lines 26-32, states:

> While the above-described process optionally includes chemical strengthening, other methods can be used to make the substrate more robust. For example, a coating can be applied to the edge of the substrate, e.g., to fill cracks, voids and the like, to reduce the possibility of crack propagation. Alternatively, one can polish the substrates to remove sharp peaks to reduce the chance of crack propagation.

should be applied. Similarly, *Bajorek* mentions polishing, but does not state anything about the polishing parameters.

The subject of *Bajorek*'s patent is the stacking of recording disks during edge finishing operations, to avoid contaminating the recording surfaces with particulate matter from finishing operations. In addition to the polishing of the edges while stacked, *Bajorek* discloses various other conventional steps which are performed in the manufacture of a recording disk, as context for his invention. Among these conventional steps is chemical strengthening.

Appellants submit that *Bajorek*'s disclosure amounts to nothing more than a statement that there *might be* alternatives to chemical strengthening, and a suggestion of two possible avenues of approach. *Bajorek* does not reduce either of these approaches to practice or demonstrate that either of these approaches would be feasible. As is well known, many patent attorneys disclose an array of potential alternatives as a means of broadening the scope of the claims. Thus, *Bajorek* intends his claims to encompass any process which uses the disclosed disk stacking technique, whether or not other steps such as chemical strengthening or alternatives to it, now known or hereafter discovered, are employed. His statements amount to mere speculation as to future developments, and do not provide the necessary teaching of how one is to construct a sufficient strong and robust glass disk without chemical strengthening.

Appellants believe that the only demonstrated, workable alternative to chemical strengthening is the ductile grinding technique taught by their disclosure.[4] For this and all the reasons stated earlier, the claims of group II are patentable over the cited art.

**9. Summary**

Appellants disclose a novel method for manufacturing glass or ceramic recording disks, in which the disk edge is finished in the ductile grinding regime, thus avoiding the need for chemical strengthening. Ductile grinding of brittle materials is an exotic, rarely used phenomenon, limited to only a few special applications. No known teaching or suggestion exists in the art to finish the edges of recording disks in the ductile grinding regime, as taught be appellants, or to combine the few known examples of ductile grinding art with conventional disk drive manufacturing art. Nor does the art disclose any practical alternative to chemical strengthening, as disclosed in appellant's disclosure.

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[4] It is theoretically possible to polish a disk edge indefinitely using conventional fine glass polishing techniques until all the cracks are gone. I.e., to remove sufficient surface depth of material by polishing so that all cracks have also been removed. But conventional polishing techniques are not intended for material removal on such a scale. Such an operation would take days, and would be totally unsuitable to the practical manufacture of disks for use in disk drives.

For all the reasons stated herein, the rejection for obviousness was improper, and appellants respectfully request that the Examiner's rejection of the claims be reversed.

Date: April 1, 2004

Respectfully submitted,

JAMES A HAGAN, et al.

By

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CERTIFICATE OF MAILING
UNDER 37 CFR 1.8(a)

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April 1, 2004
Date of Deposit

Roy W. Truelson

## APPENDIX A (CLAIMS)

1. A method for manufacturing a disk substrate for a rotating disk drive data storage device, comprising the steps of:

providing a disk substrate having a circumferential edge, said disk substrate being of a material from the set of materials consisting of: glass, ceramic, and a combination of glass and ceramic;

loading said disk substrate to an edge finishing apparatus; and

grinding said circumferential edge of said disk substrate in a ductile grinding regime using said edge finishing apparatus.

2. The method for manufacturing a disk substrate of claim 1, wherein said disk drive data storage device is a rotating magnetic disk drive data storage device, said disk substrate being subsequently coated with a magnetic coating after said grinding step.

3. The method for manufacturing a disk substrate of claim 1, further comprising the step of coarse grinding said circumferential edge in a non-ductile mode, said step of coarse grinding said circumferential edge in a non-ductile mode being performed before said step of grinding said circumferential edge in a ductile grinding regime.

4. The method for manufacturing a disk substrate of claim 1, wherein said disk substrate contains an outer circumferential edge at the periphery thereof and a central aperture defining an inner circumferential edge, and wherein said grinding step is applied to both said outer circumferential edge of said disk substrate and to said inner circumferential edge.

5. The method for manufacturing a disk substrate of claim 1, wherein said grinding step comprises grinding said edge with a formed grinding appliance conforming to an edge radius at said circumferential edge.

6. The method for manufacturing a disk substrate of claim 1, wherein said grinding step comprises bringing a grinding appliance of said edge finishing apparatus in contact with said circumferential edge and providing relative motion between said grinding appliance and circumferential edge of approximately 30 m/sec or more.

7. The method for manufacturing a disk substrate of claim 1, wherein said edge finishing apparatus comprises a grinding appliance having diamond particles of approximately 6 microns or less.

8. The method for manufacturing a disk substrate of claim 1, wherein said disk substrate is finished for installation in a disk drive data storage device without chemical strengthening of said disk substrate.

9. The method for manufacturing a disk substrate of claim 8, wherein said disk substrate is of a material which is not chemically strengthenable.

10. A method for manufacturing a disk substrate for a rotating disk drive data storage device, comprising the steps of:

providing an disk substrate having a cut, unfinished circumferential edge, said disk substrate being of a material from the set of materials consisting of glass, ceramic, and a combination of glass and ceramic, wherein said disk substrate material is not chemically strengthenable; and

finishing said circumferential edge of said disk substrate to a finished state suitable for use in a disk drive data storage apparatus using at least one edge finishing apparatus.

11. The method for manufacturing a disk substrate of claim 10, wherein said step of finishing said circumferential edge of said disk substrate comprises grinding said edge in a ductile grinding regime.

12. The method for manufacturing a disk substrate of claim 10, wherein said disk drive data storage device is a rotating magnetic disk drive data storage device, said method further comprising the step of coating at least one flat surface of said disk substrate with a magnetic coating, said coating step being performed after said grinding step.

13. The method for manufacturing a disk substrate of claim 10, wherein said disk substrate contains an outer circumferential edge at the periphery thereof and a central aperture defining an inner circumferential edge, and wherein said finishing step comprises finishing both said outer circumferential edge of said disk substrate and said inner circumferential edge.

14. The method for manufacturing a disk substrate of claim 10, wherein said step of finishing said circumferential edge grinding step comprises forming an edge radius at said circumferential edge.

15. A method for manufacturing a disk substrate for a rotating disk drive data storage device, comprising the steps of:

providing a disk substrate having a cut, unfinished circumferential edge, said disk substrate being of a material from the set of materials consisting of glass, ceramic, and a combination of glass and ceramic;

finishing said circumferential edge of said disk substrate to a finished state suitable for use in a disk drive data storage apparatus by application of mechanical forces using at least one edge finishing apparatus, said finishing step being accomplished without chemical strengthening of said disk substrate.

16. The method for manufacturing a disk substrate of claim 15, wherein said disk substrate is of a material which is not chemically strengthenable.

17. The method for manufacturing a disk substrate of claim 15, wherein said step of finishing said circumferential edge of said disk substrate comprises grinding said edge in a ductile grinding regime.

18. The method for manufacturing a disk substrate of claim 15, wherein said disk drive data storage device is a rotating magnetic disk drive data storage device, said method further comprising the step of coating at least one flat surface of said disk substrate with a magnetic coating, said coating step being performed after said grinding step.

19. The method for manufacturing a disk substrate of claim 15, wherein said disk substrate contains an outer circumferential edge at the periphery thereof and a central aperture defining an inner circumferential edge, and wherein said finishing step comprises finishing both said outer circumferential edge of said disk substrate and said inner circumferential edge.

20. The method for manufacturing a disk substrate of claim 15, wherein said step of finishing said circumferential edge grinding step comprises forming an edge radius at said circumferential edge.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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| Examiner: | E. Ojini | : | Intellectual Property Law |
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To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

## APPEAL BRIEF IN SUPPORT OF APPEAL FROM THE PRIMARY EXAMINER TO THE BOARD OF APPEALS

Applicant herewith submits an appeal brief, in triplicate, in support of the appeal to the Board of Appeals from the decision dated November 6, 2003, of the Primary Examiner finally rejecting claims 1-20.

The appeal brief fee of $330.00 is to be charged to Deposit Account No. **09-0465**. A duplicate copy of this sheet is enclosed.



Date: April 1, 2004

Respectfully submitted,

JAMES A HAGAN, et al.

By [signature]
Roy W. Truelson
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**CERTIFICATE OF MAILING UNDER 37 CRF 1.8(a)**

I hereby certify that the enclosed or attached correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Mail Stop Appeal Brief–Patents, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on

April 1, 2004
Date of Deposit

[signature]
Roy W. Truelson